

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 200300817-2 WO	FOR FURTHER ACTION See Form PCT/PEA/416	
International application No. PCT/GB2004/002983	International filing date (day/month/year) 09.07.2004	Priority date (day/month/year) 12.07.2003
International Patent Classification (IPC) or national classification and IPC H05K3/20, H05K3/46, H01L23/538		
Applicant HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P. et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 6 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand 10.05.2005	Date of completion of this report 06.10.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Batev, P Telephone No. +49 89 2399-7970	



INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/GB2004/002983

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1, 4-10	as originally filed
2, 3	filed with the demand

Claims, Numbers

12(part), 13-20, 27(part), 28-36	as originally filed
1-11, 12(part), 21-26, 27(part), 37	filed with the demand

Drawings, Sheets

1/4-4/4	as originally filed
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- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/002983

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	3-9,13-23,25-35
	No: Claims	1,2,10-12,24,36,37
Inventive step (IS)	Yes: Claims	none
	No: Claims	1-37
Industrial applicability (IA)	Yes: Claims	1-37
	No: Claims	none

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following document:

D1: US-A-4 159 222 (LEBOW SANFORD ET AL) 26 June 1979 (1979-06-26)

The broad language used in the claims does not allow the subject matter to be clearly distinguished over the prior art, and in particular, over document D1 (see the comments below referring Item VIII). The examiner considers that a "physical" interconnection exists in the cross-over structure disclosed in document D1. This document discloses two alternatives of forming the interconnection in two steps: (a) electroplating followed by etching, and (b) electroless deposition of a thin layer followed by electrodeposition.

Insofar as the examiner can understand the claims, the following is pointed out:

1. Document D1 discloses (col. 4, l. 40 - col. 5, l. 25, Figs. 6 and 7A) a cross-over of first and second separate elongate conductive interconnects, the cross-over comprising:
 - a first elongate conductive interconnect;
 - a second elongate conductive interconnect comprising:
 - a first conductive portion separate from the first conductive interconnect,
 - a second conductive portion separate from the first conductive interconnect and the first conductive portion, and
 - a third electro-deposited metal portion 62 physically interconnecting the first and second conductive portions;
 - first insulating material 50 between the first elongate conductive interconnect 30 and the third portion 62 of the second elongate conductive interconnect; and
 - a substrate 72, whereinthe first insulating material 50 and the third portion 62 are positioned between the substrate 72 and the first elongate interconnect 30.

Thus, the subject matter of claim 1 appears not novel (Article 33(2) PCT).

2. The same reasoning applies, mutatis mutandis, to the subject matter of the corresponding independent method claim 24 and independent device claim 36, which does not define any technical features but only refers back to claim 24. The subject matter of said claims seems, therefore, also not new.

3. The first insulating material of the cross-over known from document D1 directly contacts the third electro-deposited metal portion. Consequently, the subject matter of independent claim 37 also appears to lack novelty.
4. Independent claim 23 as well as dependent claims 2 - 22 and 25 - 35 do not appear to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein (see also the Guidelines, paragraph 4.05).
2. The features of the claims are not provided with reference signs placed in parentheses in order to facilitate their understanding (Rule 6.2(b) PCT, see also the Guidelines, paragraph 5.11).

Re Item VIII

Certain observations on the international application

1. The application contains three independent claims directed to a cross-over, i.e. claims 1, 36 and 37. Thus, the number of independent claims seems unreasonable with respect to the nature of the invention which the applicant seeks to protect (Rule 6.1(a) PCT).

Lack of clarity of the claims as a whole arises, since the plurality of claims directed to the same subject matter makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

The requirements of Article 6 PCT regarding conciseness and clarity are, therefore, not met (see also the Guidelines, paragraph 5.42).

2. The term "physically" having a very broad meaning, it is not possible to distinguish clearly and unambiguously the subject matter of independent claim 1, 24 and 37 over the

prior art.

Similarly, the broad wording of claim 1 does not exclude an interconnection formed in two steps, for example, electroplating followed by etching, or electroless deposition of a seed layer followed by electrodeposition.

3. Claim 36 is independent as it refers to claims of a different category. Such a claim should define clearly all essential features of the invention. However, no proper features of a cross-over are specified in said claim (see the Guidelines, paragraph 5.33).

4. The last part of the description (page 10, last two paragraphs) implies that the subject matter for which protection is sought may be different to that defined by the claims. This results in lack of clarity of the claims (Article 6 PCT) when the description is used to interpret them (see the Guidelines, paragraph 5.30).

interconnects. For example, circuitry with a matrix of conductive interconnects, such as matrix display devices, may have thousands or millions of such cross-overs.

- 5 In the bulk semi-conductor field, the conductive interconnects are normally separated into different electrically insulated layers of the semiconductor device. Vias through the insulating layers of the device are used to form electrical connection to the conductive interconnects.
- 10 In some applications, such as display devices, it is desirable to have a thin device and it is undesirable to separate, into separate electrically insulated layers, the conductive interconnects that cross-over.

- It would be desirable to provide a cross-over for conductive interconnects
- 15 without separating the conductive interconnects into different insulated layers.

BRIEF DESCRIPTION OF THE INVENTION

- The inventor has realized that a cross-over of first and second interconnects
- 20 can be formed by bridging the first conductive interconnect using electro-deposited metal that forms part of the second interconnect.

- According to one embodiment of the invention there is provided a cross-over of first and second separate elongate conductive interconnects, comprising: a
- 25 first elongate conductive interconnect; a second elongate conductive interconnect comprising: a first conductive portion separate from the first elongate conductive interconnect; a second conductive portion separate from the first elongate conductive interconnect and the first conductive portion; and
- 30 a third electro-deposited metal portion physically interconnecting the first and second conductive portions; and first insulating material between the first elongate conductive interconnect and the third electro-deposited metal portion of the

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second elongate interconnect; and a substrate, wherein the first insulating material and the third electro-deposited metal portion are positioned between the substrate and the first elongate conductive interconnect.

- 5 According to another embodiment of the invention there is provided a cross-over of first and second conductive means, comprising: first conductive means;
- second conductive means comprising: a first conductive portion separate from the first conductive means; a second conductive portion separate from
- 10 the first conductive means and the first conductive portion; and a third electro-deposited metal portion physically interconnecting the first and second conductive portions; and first insulating means for insulating the first conductive means from the second conductive means wherein the first insulating means directly contacts the third electro-deposited metal portion.

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- According to another embodiment of the invention there is provided a method of crossing a first elongate conductive interconnect and a separate second elongate conductive interconnect in an integrated circuit, comprising:
- a) forming a first elongate conductive interconnect ; b) forming a first
- 20 conductive portion separate from the first elongate conductive interconnect; c) forming a second conductive portion separate from the first elongate conductive interconnect; d) depositing first insulating material over at least a portion of the first elongate conductive interconnect; and e) electro-depositing metal to form a third electro-deposited metal portion extending over the first
- 25 insulating material to physically interconnect the first and second conductive portions and form the second elongate conductive interconnect; and f) transferring the structure formed in steps a) to e) to a substrate.

- The inventor has realized that a cross-over of first and second interconnects
- 30 can be formed by bridging the first conductive interconnect using electro-deposited metal that forms part of the second interconnect before transfer to a final

CLAIMS

1. A cross-over of first and second separate elongate conductive interconnects, comprising:

5 a first elongate conductive interconnect;

a second elongate conductive interconnect comprising:

a first conductive portion separate from the first elongate conductive interconnect;

10 a second conductive portion separate from the first elongate conductive interconnect and the first conductive portion; and

a third electro-deposited metal portion physically interconnecting the first and second conductive portions; and

first insulating material between the first elongate conductive interconnect and the third electro-deposited metal portion of the second elongate interconnect;

15 and

a substrate,

wherein the first insulating material and the third electro-deposited metal portion are positioned between the substrate and the first elongate conductive interconnect.

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2. A cross-over as claimed in claim 1, wherein the first and second elongate conductive interconnects are formed from electro-deposited metal.

3. A cross-over as claimed in claim 1 or 2, wherein the first elongate

25 conductive interconnect has a necked portion adjacent the first insulating material.

4. A cross-over as claimed in claim 3, wherein the first and second conductive portions are located on opposite sides of the necked portion of the first

30 elongate conductive interconnect.

5. A cross-over as claimed in claim 3 or 4, wherein the third electro-deposited metal portion bridges the first insulating layer where it is adjacent the necked

portion of the first elongate conductive interconnect.

6. A cross-over as claimed in any preceding claim, having a first layer and a second layer, wherein the first elongate conductive interconnect occupies at least the first layer and the second elongate conductive interconnect occupies the first and second layers.

7. A cross-over as claimed in claim 6, wherein the first layer comprises at least a portion of the first elongate conductive interconnect, the first conductive portion, the second conductive portion and second insulating material between the first conductive portion and the first elongate conductive interconnect and between the second conductive portion and the first elongate conductive interconnect and the second layer comprises first insulating material adjacent at least a portion of the first elongate conductive interconnect, and the third interconnecting metal portion.

8. A cross-over as claimed in claim 7, wherein the first and second insulating material enclose a portion of the first elongate conductive interconnect.

9. A cross-over as claimed in any preceding claim, wherein the first insulating material forms a layer that is elongated in the same direction as the elongate first conductive layer.

10. A cross-over as claimed in any preceding claim, wherein the first elongate conductive layer is formed wholly from metal.

11. A cross-over as claimed in any preceding claim, wherein the first elongate conductive layer comprises electro-deposited metal.

12. A cross-over as claimed in any preceding claim, wherein the first elongate conductive interconnect is formed from the same material as the first and second

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21. A cross-over as claimed in claim 20, wherein the substrate is flexible

22. A cross-over as claimed in claim 20 or 21, wherein the substrate is made from plastics.

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23. An active-matrix display, comprising a plurality of cross-overs as claimed in any preceding claim.

24. A method of crossing a first elongate conductive interconnect and a separate second elongate conductive interconnect in an integrated circuit, comprising:

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a) forming a first elongate conductive interconnect ;

b) forming a first conductive portion separate from the first elongate conductive interconnect;

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c) forming a second conductive portion separate from the first elongate conductive interconnect;

d) depositing first insulating material over at least a portion of the first elongate conductive interconnect; and

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e) electro-depositing metal to form a third electro-deposited metal portion extending over the first insulating material to physically interconnect the first and second conductive portions and form the second elongate conductive interconnect; and

f) transferring the structure formed in steps a) to e) to a substrate.

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25. A method as claimed in claim 24, wherein step d) involves forming a first insulating layer over a necked portion of the first elongate conductive interconnect.

26. A method as claimed in claim 24 or 25, wherein step d) involves the selective retention of photo-curable material.

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27. A method as claimed in any one of claims 24 to 26, wherein, in step a), the

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37. A cross-over of first and second conductive means, comprising:

first conductive means;

second conductive means comprising:

a first conductive portion separate from the first conductive means;

5 a second conductive portion separate from the first conductive means
and the first conductive portion; and

a third electro-deposited metal portion physically interconnecting the
first and second conductive portions; and

first insulating means for insulating the first conductive means from the

10 second conductive means wherein the first insulating means directly contacts
the third electro-deposited metal portion.